

CLAIMS

What is claimed is:

1. A method for cleaning an article containing contaminants comprising:
 - 5 (a) providing a zeotropic solvent composition comprising at least one flammable solvent having a boiling point at a first pressure, at least one first nonflammable solvent having a boiling point at said first pressure less than about the first pressure boiling point of said flammable solvent, and at least one second nonflammable solvent having a boiling point at said first pressure
10 greater than about the first pressure boiling point of said flammable solvent; and
 - (b) contacting the article with said zeotropic solvent composition to remove at least a portion of the contaminants from said article.
- 15 2. The method of claim 1 wherein said contacting step comprises contacting the article with a stream comprising said zeotropic composition.
3. The method of claim 2 wherein said contacting step comprises passing said
20 stream across the article.
4. The method of claim 1 wherein said contacting step comprises immersing the article in said zeotropic solvent composition.
5. The method of claim 1 wherein said providing step comprises providing a
25 liquid phase comprising said zeotropic solvent composition and providing a vapor phase comprising said zeotropic solvent composition, and said immersing step comprises immersing the article in said liquid phase and in said vapor phase.
- 30 6. The method of claim 1 wherein said contacting step comprises spraying the article with said zeotropic solvent composition.
7. The method of claim 2 wherein said zeotropic solvent composition is in vapor
35 phase for at least a portion of the contacting step.
8. The method of claim 1 wherein at least a portion of the contacting step is conducted in a vapor degreaser.

9. The method of claim 1 wherein said flammable solvent is selected from the group consisting of isomers of HFC-365, methylal, ethylal, cis and trans dichloroethylene, isopropyl chloride, pentane and other C₁-C₂₀ hydrocarbons, C₁-C₂₀ hydrocarbon alcohols, and C₁-C₂₀ hydrocarbon ketones.
- 5 10. The method of claim 1 wherein said flammable solvent comprises trans-1,2-dichloroethylene.
- 10 11. The method of claim 1 wherein at least one said nonflammable solvents is selected from the group consisting of HFC-245fa and other isomers of HFC-245, isomers of HFC-236, isomers of HFC-356, HFC-4310, HCFC-141b, isomers of HCFC-225, isomers of HCFC-123, isomers of HCFC-124, HFE-7100, HFE-7200, trichloroethylene, perchloroethylene, n-propyl bromide, and nonflammable fluoroiodocarbons.
- 15 12. The method of claim 10 wherein said at least one first nonflammable solvent comprises HFC-245fa.
- 20 13. The method of claim 10 wherein said at least one second nonflammable solvent comprises HFE-7100.
- 25 14. The method of claim 12 wherein said at least one second nonflammable solvent comprises HFE-7100.
- 30 15. A zeotropic solvent composition comprising in a zeotropic relationship:
- (a) at least one flammable solvent having a boiling point at a first pressure;
 - (b) at least one first nonflammable solvent having a boiling point at said first pressure which is less than about the boiling point of said flammable solvent; and
 - (c) at least one second nonflammable solvent having a boiling point at said first pressure which is greater than about the boiling point of said flammable solvent.
- 35 16. The composition of claim 15 wherein said flammable solvent is an azeotropic combination of at least two compounds.

17. The composition of claim 15 wherein at least one of said nonflammable solvents is an azeotropic combination of at least two compounds.
- 5 18. The composition of claim 15 wherein said flammable solvent is selected from the group consisting of isomers of HFC-365, methylal, ethylal, cis and trans dichloroethylene, isopropyl chloride, pentane and other C₁-C₂₀ hydrocarbons, C₁-C₂₀ hydrocarbon alcohols, and C₁-C₂₀ hydrocarbon ketones.
- 10 19. The composition of claim 15 wherein said flammable solvent comprises trans-1,2-dichloroethylene.
- 15 20. The composition of claim 15 wherein at least one said nonflammable solvents is selected from the group consisting of HFC-245fa and other isomers of HFC-245, isomers of HFC-236, isomers of HFC-356, HFC-4310, HCFC-141b, isomers of HCFC-225, isomers of HCFC-123, isomers of HCFC-124, HFE-7100, HFE-7200, trichloroethylene, perchloroethylene, n-propyl bromide, and nonflammable fluoroiodocarbons.
- 20 21. The composition of claim 15 wherein said at least one first nonflammable solvent comprises HFC-245fa.
22. The composition of claim 15 wherein said at least one second nonflammable solvent comprises HFE-7100.
- 25 23. The composition of claim 21 wherein said at least one second nonflammable solvent comprises HFE-7100.
24. The composition of claim 15 wherein said first pressure is about one atmosphere.
- 30 25. A sprayable composition comprising a composition according to claim 15.

26. A method for cleaning an article containing contaminants comprising vapor degreasing said article in the substantial absence of any flammable vapor or liquid phase, the method comprising the steps of:
- 5 (a) providing a zeotropic solvent composition comprising at least one flammable solvent having a boiling point at a first pressure, at least one first nonflammable solvent having a boiling point at said first pressure less than about the first pressure boiling point of said flammable solvent, and at least one second nonflammable solvent having a boiling point at said first pressure greater than about the first pressure boiling point of said flammable solvent;
- 10 and
- (b) contacting the article with said zeotropic solvent composition to remove at least a portion of the contaminants from said article.
27. The method of claim 26 wherein said first pressure is about one atmosphere.
- 15 28. The method of claim 26 wherein said contacting step comprises immersing the article in a said zeotropic solvent composition.
29. The method of claim 26 wherein said providing step comprises providing a liquid phase comprising said zeotropic solvent composition and providing a vapor phase comprising said zeotropic solvent composition, and said immersing step comprises immersing the article in said liquid phase and in said vapor phase.
- 20 30. The method of claim 26 wherein said contacting step comprises spraying the article with said zeotropic solvent composition.
- 25 31. The method of claim 26 wherein said flammable solvent is selected from the group consisting of isomers of HFC-365, methylal, ethylal, cis and trans dichloroethylene, isopropyl chloride, pentane and other C₁-C₂₀ hydrocarbons, C₁-C₂₀ hydrocarbon alcohols, and C₁-C₂₀ hydrocarbon ketones.
- 30 32. The method of claim 26 wherein said flammable solvent comprises trans-1,2-dichloroethylene.
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33. The method of claim 26 wherein at least one said nonflammable solvents is selected from the group consisting of HFC-245fa and other isomers of HFC-245, isomers of HFC-236, isomers of HFC-356, HFC-4310, HCFC-141b, isomers of HCFC-225, isomers of HCFC-123, isomers of HCFC-124, HFE-7100, HFE-7200, trichloroethylene, perchloroethylene, n-propyl bromide, and nonflammable fluoroiodocarbons.

34. The method of claim 26 wherein said at least one first nonflammable solvent comprises HFC-245fa.

35. The method of claim 26 wherein said at least one second nonflammable solvent comprises HFE-7100.

36. The method of claim 34 wherein said at least one second nonflammable solvent comprises HFE-7100.